

FIG. 4.—Average barometer and temperature changes and precipitation areas in the type causing fair weather "to-night and to-morrow" at Duluth during March.

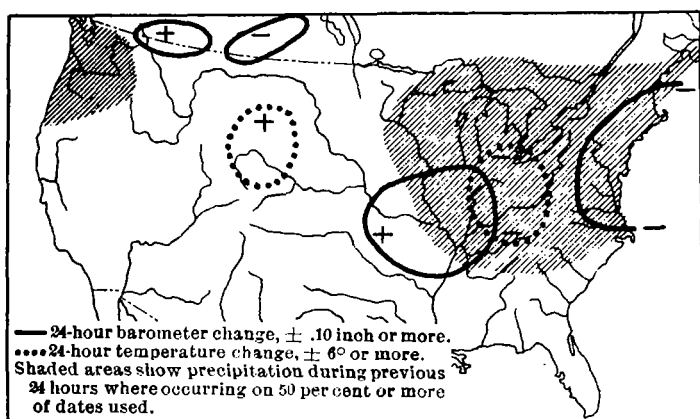


FIG. 3.—Composite or average type causing fair weather "to-night and to-morrow" at Duluth during March.

Weather, temperature, and wind, and three maps are used daily (except Sundays and holidays), one for each condition. Each map includes precipitation, pressure, and temperature change areas in black, red, and blue pencil, respectively, and the paths of the pressure areas are also indicated. On each map are also brief notations covering weather, temperature, and wind for to-night and to-morrow; thus each individual map contains a complete history of the conditions that followed during the succeeding twenty-four and thirty-six hours and their relation to a particular type. As the types accumulate they are pasted together and each group is plainly marked. Thus we have all the fair weather maps together, and the same for rain or snow, cold waves, colder, warmer, stationary temperature, high or light winds, etc. A complete set of these types has been arranged for each month of 1902, the labor requiring but a little time each day.

(C.) In the scrapbook plan a conveniently large blank book is used. A year's supply of 2 by 4-inch maps of the United States and Canada were milliographed. Two of these maps are used daily (including Sundays and holidays). The maps are of a size that permits four being used on a page. On the left-hand page are pasted (in chronological order) the maps containing isobars and isotherms, and on the opposite or right-hand page are pasted maps showing precipitation, areas of pressure and temperature changes for dates corresponding to maps on the left. Progressive movements of the highs and lows are indicated. The local and State forecasts are entered opposite the appropriate map, and likewise data as to weather, temperature, and wind conditions that resulted "to-night and to-morrow." The arrangement is such that when the book is open eight maps for four dates are at once in view.

Besides preparing the maps in the manner described, a system of indexing is also followed. In the front part of the book are pages devoted to the various types of weather, temperature, and wind, each map (or date) being given a number. This shows the frequency and continuity of each type. It not only affords a study of individual types, but also furnishes a method of studying those whose movements extend over periods of several days.

In all the foregoing arrangements of types the 24-hour pressure changes were used, instead of those for twelve hours. This was rendered necessary by reason of the fact that the 12-hour changes were available only for the Northwest; therefore they were of little value.

Among the features developed by these studies is the apparent tendency of the highs and lows to move from near the center of a pressure change area to the edge of the same area or to a point between the plus and minus areas in twenty-four hours. When the highs and lows lie between plus and minus areas they frequently move to near the center of the pressure change areas in twenty-four hours. As these areas are generally of irregular size and conformation, so, also, the movements of the highs and lows become little or great accordingly. While the rules do not always obtain, yet the occurrence is so frequent as to be of some value in forecasting when considered in connection with the other laws governing atmospheric motion.

#### METEOROLOGY IN THE NATIONAL AGRICULTURAL INSTITUTE OF FRANCE.

By Miss R. A. EDWARDS, Library, Weather Bureau.

The National Agricultural Institute of France has recently issued the first volume of the second series of its *Annales*, which appears on the occasion of the twenty-fifth anniversary of the Institute. From the introduction we learn that the special purpose of this volume is to present to the agricultural and scientific world the history, the work, and the organization of this institution. Condensed accounts are given of the various courses of instruction offered, among which we notice meteorology. Teachers in general, and especially those in the colleges and technical schools of this country, may be interested to know to what extent meteorology receives attention in other countries. This course consists of twenty-five lectures delivered by Prof. Alfred Angot, the well-known meteorologist of the Bureau Central, who also holds the chair of physics and meteorology in the National Agricultural Institute of France. The following is a translation of the syllabus of his lectures.

Object and subdivisions of meteorology. Relations of meteorology to the other sciences, e. g., geography, agriculture, hygiene, history.

General methods of calculation. Averages; discussion of their value; application of graphic methods to the representation of phenomena.

Actinometry. Annual and diurnal variation of the quantity of heat received in different latitudes; influence of the atmosphere and the atmospheric absorption of solar rays; measure of the quantity of heat and of light which reach the soil; actinometers.

Temperature of the soil. Diurnal and annual variations of the temperature of the soil at different depths; effect of sod covering; of snow covering; variation of average temperature with depth.

Temperature of waters. Springs, rivers, lakes; annual variation; temperature of the sea at surface and at depths; of ocean currents; limits of icebergs.

Temperature of air. Methods of observation; thermometers, maximum, self-registering, sling; installation of thermometers.

Diurnal variations of the temperature of the air; influence of seasons; of latitude; of topographical conditions. Annual variation of temperature; climates, equable, temperate, extreme; variation of temperature of atmosphere with altitude.

General distribution of temperature at the surface of the globe by the annual averages and by the different seasons; extreme temperatures observed in different regions.

Influence of temperatures on phenomena of vegetation; effect of frosts; of altitude; limits of different vegetations; influence of temperature on animal life.

Atmospheric pressure. Instruments for measurement; barometers; aneroid, mercurial self-registering; thermometric-hypsometry; diurnal and annual variation of atmospheric pressure.

Variation of pressure with altitude. Laplace's formula; applications; reduction of pressure to sea level; calculation of altitudes by means of barometric observations.

Wind. Measurement of direction and of velocity of wind; weather vanes; velocity anemometers; pressure anemometers.

Diurnal variation of velocity and of direction of wind. Variation of wind with altitude; general relation between the wind and pressure; gradients; theory of atmospheric movements; relation of wind to temperature; influence of rotation of earth; deviation of wind on gradient.

General circulation of the atmosphere. Regular winds; trades, antitrades; distribution of wind and pressure at the surface of the globe; seasonal winds; monsoons; diurnal winds; land and sea breezes, mountain and valley breezes.

Atmospheric vapor. Evaporation; measure of evaporation; diurnal and annual variations of evaporation; general laws of evaporation.

Atmospheric humidity. Elastic force of water vapor; relative humidity; instruments of measurement; hygrometers; chemical; condensation; self-registering; psychrometer.

Diurnal and annual variations of humidity. Variation of humidity with height; distribution of humidity at surface of earth; condensation of water vapor, various modes of condensation in the ascending currents of air; dryness in the descending currents; production of the foehn.

Properties and constitution of clouds and fogs. Cloudiness; measure of cloudiness; heliograph; annual and diurnal variations of cloudiness; general distribution of cloudiness at the surface of the earth; study of movements of clouds; classification of clouds; average altitude of different forms of clouds.

Optical phenomena of the atmosphere. Rainbows; halos; coronas.

Dew and Frost. Formation of dew; measurement of dew; practical importance of these phenomena; frost; hoar frost; glazed frost.

Rain, snow, hail. Measurement of rain; rain gages, their installation. Theory of the formation of rain. Rains of various origins; rains due to convection; cyclonic rains; rains due to orography; influence of topographical conditions, of forests.

General distribution of rains at the surface of the globe. Rainy regions; desert regions; detailed study of rain in the different regions; rainfall system; distribution of rain throughout the seasons; intensity of heavy showers.

Snow. Constitution and density of snow; effect of snow; limits of perpetual snow.

Natural utilization of meteoric waters. Percolation; surface flow; water consumed by evaporation and by vegetation; supply of underground waters, of springs, and of rivers; drainage system of water; risings and floods, their prevision.

The law of storms. Depressions of temperate latitudes and cyclones of tropical regions, their constitution; distribution of wind about centers of low pressure.

Influence of barometric depression on the weather. Local winds produced by the passage of depressions; mistral, sirocco, foehn, bora, etc.

Laws of movements and of frequency of barometric depressions and of cyclones; their velocity, their average paths. Various causes of the circulatory movement; causes which tend to modify their velocity, their paths, or their intensity.

Anticyclones, their origin. Influence of anticyclones on the weather.

Thunderstorms. Atmospheric electricity, lightning, flash of lightning, thunder; frequency of hourly, seasonal, and geographical distribution of thunderstorms; origin of thunderstorms, thunderstorms of heat, and cyclonic thunderstorms; hail, formation of hail; means proposed for defense against hail.

Whirlwinds and waterspouts, their effects, their origin, and their relations to thunderstorms; heat storms.

Forecasting. Short range system of forecasting; organization of forecast service; general principles of forecasting.

Forecasting by isolated observers. Utilization of observations and of local signs; prevision of frost in spring time.

Discussion of attempts to forecast at long range.

Cosmical influences. Periodicity of sunspots, discussion of relations they present to meteorological phenomena. Discussion of influences attributed to the moon; reddish sunset; other influences attributed to cosmical causes.

Problem of variability of climates. Can man influence climate? Effect of deforestation, of reforestation.

Attempts to produce rain.

## RECENT PAPERS BEARING ON METEOROLOGY.

W. F. R. PHILLIPS, in charge of Library, etc.

The subjoined titles have been selected from the contents of the periodicals and serials recently received in the library of the Weather Bureau. The titles selected are of papers or other communications bearing on meteorology or cognate branches of science. This is not a complete index of the

meteorological contents of all the journals from which it has been compiled; it shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau. Unsigned articles are indicated by a —.

*Quarterly Journal of the Royal Meteorological Society. London. Vol. 29.*

Bayard, F. C. English Climatology, 1881-1900. Pp. 1-21.

— The Bora in the Adriatic. P. 21.

Bellamy, C. V. The Rainfall of Dominica. Pp. 23-28.

Bellamy, C. V. Notes on the Climate of Cyprus. Pp. 29-44.

Clayton, H. Helm. The Eclipse Cyclone of 1900. Pp. 47-52.

— St. Elmo's Fire. [Note on letters from J. Fellows and Charles Dibdin.] Pp. 55-56.

— Rainfall of the Hawaiian Islands. [Note on pamphlet by C. J. Lyons.] Pp. 56-57.

*Terrestrial Magnetism. Baltimore. Vol. 7.*

Bauer, L. A. Results of International Magnetic Observations made during the Total Solar Eclipse of May 18, 1901, including results obtained during previous Total Solar Eclipses. Pp. 155-192.

Pegram, Geo. B. Elster's and Geitel's researches on the Radio-Activity and the Conductivity of the Air. Pp. 202-204.

*Symons's Meteorological Magazine. London. Vol. 38.*

Stupart, R. F. The Canadian Climate. Pp. 1-4.

— Temperature of Air and Rivers. [Note on paper by W. Andson.] Pp. 4-6.

*Proceedings of the Royal Society. London. Vol. 71.*

Chree, C. Preliminary Note on the Relationships between Sunspots and Terrestrial Magnetism. Pp. 221-224.

Taylor, J. E. Characteristics of Electric Earth-current Disturbances, and their Origin. Pp. 225-227.

Evershed, J. Solar Eclipse of 1900, May 28. General Discussion of Spectroscopic Results. Pp. 228-229.

*Science. London. N. S. Vol. 17.*

Ward, R. DeC. Scientific Investigations by Weather Bureau men. Pp. 353-354.

Ward, R. DeC. Cycles of Precipitation in the United States. [Note on article by L. H. Murdoch.] P. 354.

*Astrophysical Journal. Chicago. Vol. 17.*

Langley, S. P. The "Solar Constant" and related problems. Pp. 89-99.

Bigelow, Frank H. Reply to E. von Oppolzer's remarks on Bigelow's "Eclipse Meteorology." Pp. 161-163.

*Journal of Geography. Chicago. Vol. 2.*

— How the Weather Fixes Train Loads. Pp. 45-46.

*Journal of the Franklin Institute. Philadelphia. Vol. 165.*

Auria, Luigi d'. Relation between the Mean Speed of Stellar Motion and the Velocity of Wave Propagation in a Universal Gaseous Medium Bearing upon the Nature of the Ether. Pp. 207-211.

*Engineering News. New York. Vol. 48.*

Clarke, Ernest Wilder. Storm flows from city areas, and their calculation. Pp. 386-388.

*Nature. London. Vol. 67.*

Lockyer, William J. S. Solar prominences and terrestrial magnetism. Pp. 377-379.

Marriott, Wm. Fall of Coloured Dust on February 22-23. Pp. 391.

B., G. H. The Fata Morgana of the Straits of Messina. Pp. 393-394.

Lockyer, William J. S. Indian Rainfall. Pp. 394-395.

Chree, Charles. Magnetic Work in New Zealand. Pp. 418-419.

*Geographical Journal. London. Vol. 21.*

— Circulation of the Atmosphere in the Tropical and Equatorial Regions. [Note on statement by Professor Hildebrandsson.] Pp. 298-301.

*London, Edinburgh, and Dublin Philosophical Magazine. London. 6th Series. Vol. 5.*

Wilderman, Meyer. Theory of the Connexion between the Energy of Electrical Waves or of Light introduced into a System and Chemical Energy, Heat Energy, Mechanical Energy, etc., of the same. Pp. 208-226.

Makower, Walter. On a Determination of the Ratio of the Specific Heats at Constant Pressure and at Constant Volume for Air and Steam. Pp. 226-238.

Schuster, Arthur. The influence of Radiation on the Transmission of Heat. Pp. 243-257.

Thomson, J. J. On the Charge of Electricity carried by a Gaseous Ion. Pp. 346-355.

*Journal de Physique. Paris. 4me série. Tome 2.*

Baillaud, J. L'influence des atmosphères d'azote et d'hydrogène sur les spectres d'arcs du fer, du zinc, du magnésium, et de l'étain, comparée avec celle d'une atmosphère d'ammoniaque. [Note on article by Royal A. Porer.] Pp. 128-129.

Gradenwitz, A. Comparaison des thermomètres à platine et à hydrogène. [Note on article by B. Meilink.] Pp. 137-138.